CAR PLATE DETECTION SYSTEM

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A report submitted in partial fulfillment of the requirements for the award of the degree of Bachelor of Electrical Engineering (Electronics)

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JUNE 2012

ABSTRACT

Basically, the system using human eyes to detect the car plate and manually compare the plate number through the report file. Sometimes it will take a long time to search. Then this project is developing to make human work easily. The mainly purpose of this system is to monitor and identify vehicles by their license plate. This system can be used in widely applications such as section control, border crossings, entrance security, parking security and road traffic control. The advantage of this system is no need to add any transmitter or special sign on the vehicles because the car plate already have their own identification by referring to their registration car plate number. The image of the driver also can be captured and stored to make this system more secure. The optical character recognition (camera or video) is the main technique in identify every each of the character on the car plate and going through the process of image processing. That means this project is helping and making human easily monitoring the car and captures the image with the new development technology. The result of this system will display through the Graphical User Interface (GUI).

ABSTRAK

Pada asasnya, sebelum sistem ini dibina, pengesanan nombor plat kenderaan hanya menggunakan mata manusia dan secara manual membandingkan nombor plat melalui file simpanan. Kadang-kadang ia akan mengambil masa yang lama untuk mencari dan mengesan nombor kenderaan tersebut. Kemudian sistem ini direka khas untuk membuat kerja-kerja manusia menjadi mudah dan cepat. Tujuan utama system ini direka adalah untuk memantau dan mengenal pasti nombor plat lesen kenderaan individu. Aplikasi penggunaan sistem ini adalah secara meluas contohnya ia bole digunakan pada kawalan seksyen, lintasan sempadan, keselamatan pintu masuk, keselamatan tempat letak kereta dan kawalan lalu lintas jalanraya. Kelebihan sistem ini adalah tidak perlu untuk menambah pemancar atau tanda khas pada kenderaan kerana plat kereta sudah mempunyai pengenalan diri mereka sendiri dengan merujuk kepada plat nombor pendaftaran kereta mereka. Imej pemandu juga boleh ditangkap dan disimpan untuk membuat sistem ini lebih selamat. Pengecaman aksara optik (kamera atau video) adalah teknik utama dalam mengenal pasti setiap setiap karatek pada nombor plat kereta dan akan melalui proses pemprosesan imej. Ini bermakna projek ini membantu dan membuat manusia mudah untuk memantau kereta dan menangkap imej dengan pembangunan teknologi baru. Penggunaa Antara Muka Pengguna Grafik (GUI) adalah untuk paparan hasil pemprosesan imej pada gambar tersebut.

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LIST OF ABBREVIATIONS

CPD	-	Car Plate Detection
ANN	-	Artificial Neural Network
GUI	-	Graphical User Interface

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CHAPTER 1

INTRODUCTION

1.1 Background

The Car Plate Detection Systems (CPD) is one of the most important applications in transportation. This system firstly introduced by the Police Scientific Development Branch, United Kingdom in 1976 and known as Automatic Number Plate Recognition (ANPR). The mainly purpose of this system is to monitor and identify vehicles by their license plate. This system can be used in widely applications such as section control, border crossings, entrance security, parking security and road traffic control. The advantage of this system is no need to add any transmitter or special sign on the vehicles because the car plate already has their own identification by referring to their registration car plate number. The image of the driver also can be captured and stored to make this system more secure. This may help any case in crime investigation. The optical character recognition is the main technique in identifying every each of the characters on the car plate and going through the process of image processing.

The system is to help human automatically detect plate number without using human eyes. As we know before, humans are needed to observe and list the user car plate number manually. That means this project is helping and making human easily

monitoring the car and captures the image with the new development technology. In the other hands, this system will automatically analyze and view the output result of the car status by comparing it with the database. These easily alert the user if the car is in observation or not.

1.2 Problem Statement

Nowadays, the vehicle in Malaysia has been increasing on the road today. Because of that problem, it is difficult for law enforcement and security to monitor the vehicles. For example, at the entrance gate, it is time consuming for the security to physically check the car plate every day. As a solution, this simple system is designed to identify the car plate was developed.

1.3 Objectives of project

The objectives of this project are:

i. To develop car plate detection systems using Image Processing and MATLAB tools.

ii. To develop a system that can determine the location of the character on the car plate.

iii. To design a simple and easy understanding Graphical User Interface (GUI).

1.4 Scope of Project

The scopes of this project are:

i. The car plate detection system focus on the Malaysia standard car (except for Sabah, Sarawak and Putrajaya) type of car plate and it must on single line type car plate.
ii. The systems automatically detect and captured any car plate and recognize all the characters on the car plate.
iii. The Graphical User Interface (GUI) is simple and easy understanding that compatible with Windows operating systems.

1.5 Thesis outline

This thesis consists of five chapters:

Chapter 1: discuss about the background of study of the project, the problem statements, the objectives and the scope of the project.

Chapter 2: discuss more on theory and literature reviews that has been done in this project. Besides, the techniques that have been used in this project also well discuss in this chapter from the image processing until the process end of the system.

Chapter 3: the methodology of the system will be discussed in this chapter including the image processing and the MATLAB software.

Chapter 4: the result and discussion will be discussed in this chapter.

Chapter 5: in this last chapter of the thesis will discuss the conclusions and the future recommendations for this system.

CHAPTER 2

LITERATURE REVIEW

Introduction

Car Plate Detection System (CPD) is a system that allows detecting the character images of number car plate that stored on hard disk. The systems used to store images of number plate of vehicles and automatically analyze the character on the image using Digital Image Processing System. It is widely used in police enforcement, traffic control, electronic toll collection, gate entrance, border crossings and etc. [1][7]

The CPD system can be used to control and recognize any vehicle that make any violation traffic rules, such as entering the private property area, UMP gate entrance, crossing red light, breaking speed limits ; etc.

Car plate detection system is a new technology in automatic monitoring traffic by using image processing. The system has two unit generic parts; Capture unit and Process unit. The capture unit responsible to capture the car plate image and process unit will process and analyze the image captured. The techniques that implemented in this system are digital image processing and artificial neural network (ANN). [7]

2.1 Capture Unit

The first step of the system is to detect the presence of the vehicle then automatically captured the image of the vehicle at the right time. There are three kinds of trigger control exist; hardware trigger, software trigger and free flow. [7]

Once the vehicle is detected, the following step is capturing the vehicle image. To make the image taken at a right time, there are several things to be considered;

i. Type of camera
ii. Lighting management (in daylight and night)
iii. Distance between the car plate and camera

After all above has been considered, then the image stored in hard disk to be analyzed on the next stage.

2.2 Digital Image Processing

Digital image processing is the system that use of computer algorithms to perform image processing on digital images. The advantages of using this technique are: [10]

i. Allows a much wider range of algorithms to be applied to the input data.
ii. Can avoid noises and signal distortion during processing.
iii. Can be modeled in the form of multidimensional systems.
iv. Offer more sophisticated performance of simple tasks.

The approach concerns stages of preprocessing, edge detection, filtering, detection of the plate position, slope evaluation and character segmentation and recognition. The image will be converted to single frame gray-level images for source of information.

There are four primary algorithms that the software requires for identifying a car plate number:

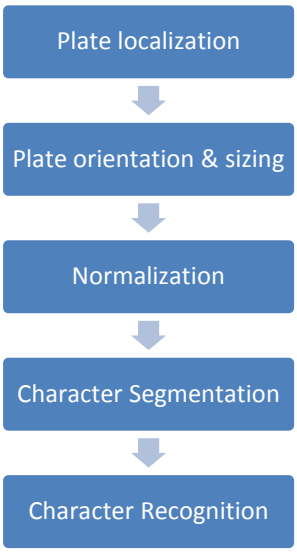

Figure 2.1: The four primary algorithms

Each primary above is the programs to determine the accuracy of the system. On the normalization phase, the systems need to use the edge detection technique to increase the picture difference between the letters and the background plates. Luckily, the standard Malaysian license plate number is in black and white color, it's easy for the system to detect and analyze it in a gray - level image. [3][4][5]

2.2.1 Plate Detection

This is the phase to identify the car plate area in an image. It will compose of image processing or plate enhancement phase. This helps to enhance the signal in the car plate area and attenuate it elsewhere and the actual plate detection phase. More powerful the enhancement of the image, the more trivial the plate detection will be.
This phase faced many difficulties related to the application. Assume that the image contains little information but the car in case of automatic pay tolls, thus the car

probably the only high frequency area of the image. Other cases probably become problem with this system when at the street monitoring, it is not clear where exactly the plate will be, the background can be rather complex, then localization will be difficult.

To satisfy the performance of the system, it is useful to use the prior on the application and on the system position. Also, even more than in general purpose text detection systems. The automatic plate detection only can rely on:

i. Car plates are meant to be read, thus letters and background are usually in a good contrast
ii. The fonts used are usually simple
iii. The digits are included in a rectangle or square box
iv. Usually aligned on one or two rows
v. Colors, fonts and size depend on the car origin country

2.2.2 Normalization

The normalization phase is used in this project is the morphological process that applied onto the image aim to remove all unrelated objects in the image and ensure that characters on the license plate are well preserved. A number of morphological processes will be applied to the image to make sure the algorithm is robust enough to cater for characters of varying sizes and scale. Also it's performed to loose upper and lower limit is specified for each process. There are three main processes applied to the image:

i. The width
ii. The height
iii. The number of holes of each individual object of the binary image is checked.

Those exceeding the specified upper and lower limits will be removed from the image. It can be solved by fill, clear boundary objects and small objects removal processes. The figure below is the morphological process of the image: [2]

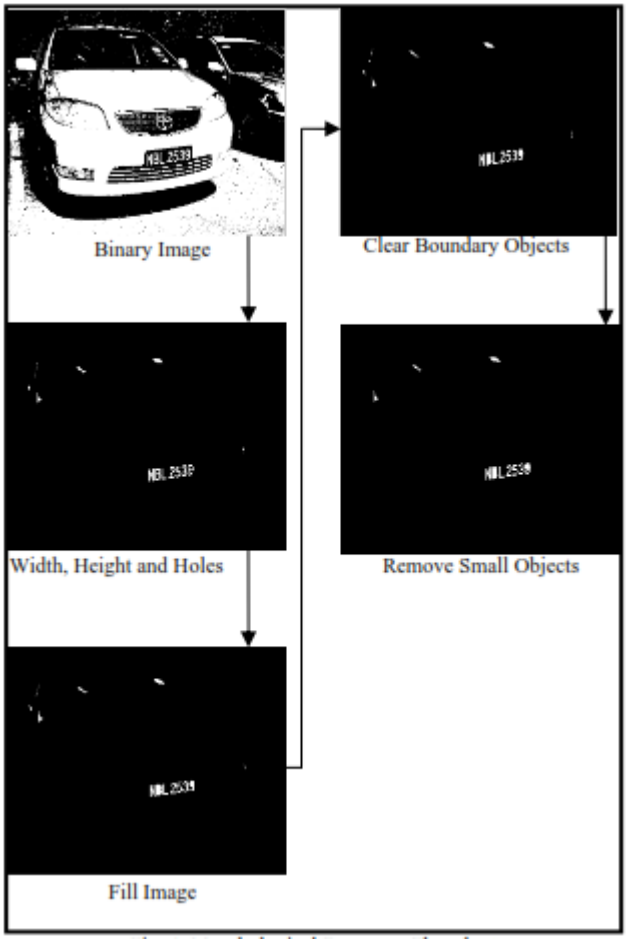

Figure 2.2: The morphological process of car plate image

2.2.3 Character segmentation

The character segmentation is a bridge between the license plate extraction and optical character recognition modules. The main function of this phase is to segmentate the characters on the chosen candidate region such that each character can be sent to the optical character recognition module individually for recognition.

The characters on the license plate can be extracted by determining the required location of the bounding box of each object in the chosen candidate region. Then, for each of the extracted bounding boxes, the object with the maximum area is retained and all other objects are removed. The process of the character segmentation illustrated below: [2]

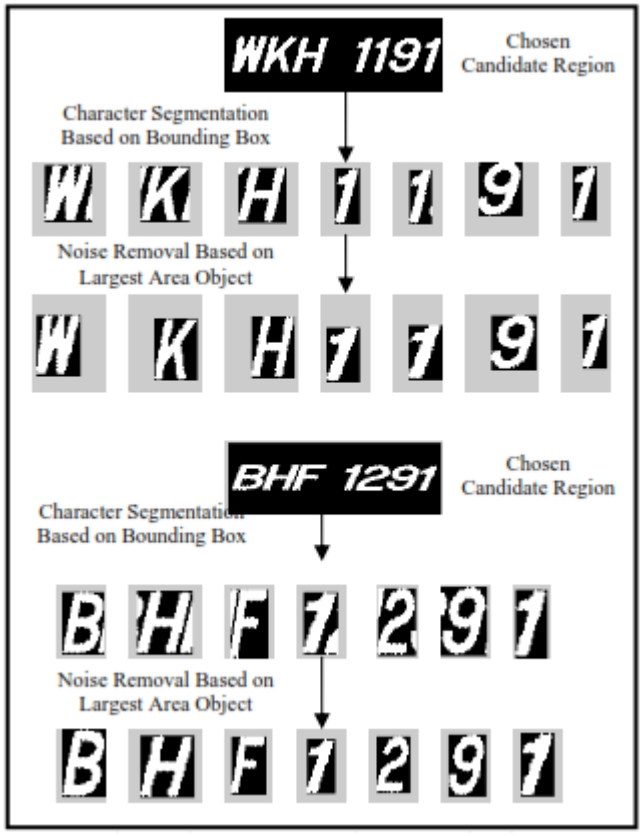

Figure 2.3: The segmentation process of car plate image

The characters are normalized into required size of pixels, this important to allow the recognition of the segmented characters via artificial neural networks in the character recognition module.

2.3 Character recognition

The problem for this phase is being posed as a classification or categorization task, where the classes are either defined by the system designer or are learned based on the similarity of the patterns. The demands of automatic pattern recognition systems are rising enormously due to the availability of large databases and stringent performance requirements. The design involves three aspects; [3][2]

i. Data acquisition and preprocessing
ii. Data representation
iii. Decision making

The learning from the set of examples (training sets) is an important and desired attribute of most pattern recognition systems. There are four best approaches for pattern recognition:[3]

i. Template matching
ii. Statistical classification
iii. Syntactic or structural matching
iv. Neural network

2.3.1 Artificial Neural Network (ANN)

An Artificial Neural Network (ANN) is inspired by the structure and/or functional aspects of biological neural networks. In other words, the ANN is a data analysis methods and algorithms. It is an adaptive system that changes its structure based on external or internal information during the learning phase. It's suitable for making the car plate detection system. [11][3]

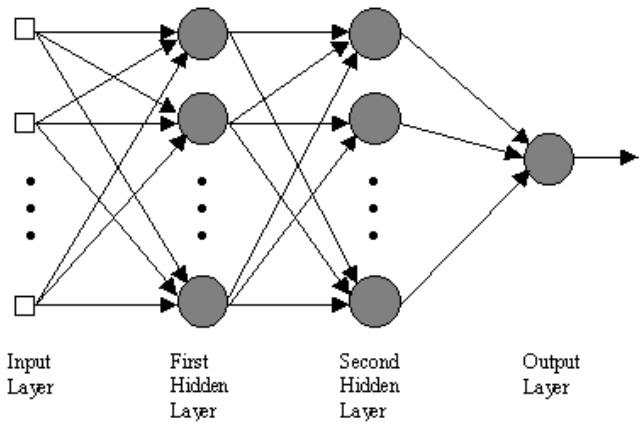

Figure 2.4: The example of three layer feed-forward Neural Network

The ANN is defined by three types of parameters. First is the interconnection pattern between different layers of neurons. Follow by The learning process for updating the weights of the interconnections. Last is the activation function that converts a neuron's weighted input to its output activation. [11][3]

2.4 MATLAB

MATLAB is a high-level language and interactive environment that enable for user to perform computationally intensive task faster that with traditional programming language, C++. The software was developed by The MathWorks and can allows matrix manipulations, plotting of functions and data, implementation of algorithm, creation of simple user interface and interfacing with program written in other languages.

The software has many applications toolbox especially the Image Processing Toolbox. It's a collection of functions that extended the capability of the MATLAB numeric computing environment. In image processing toolbox, it support various operations including the spatial image transformation, morphological operations,

neighborhood and block operation, linear filtering, filtering design, transformation, image analysis and enhancement, image registration and region interest operations.